KENT STATE UNIVERSITY

KENT STATE UNIVERSITY PHYSICS COLLOQUIUM

Thursday, October 3, 2019
Smith Hall Rm 111 / 1:30pm
Refreshments @ 1:15pm

Dr. Igor S Aranson

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ENGINEERING SPATIAL-TEMPORAL ORGANIZATION OF BACTERIAL SUSPENSIONS

Suspensions of motile bacteria or synthetic microswimmers, termed active matter, manifest a remarkable propensity for self-organization and formation of large-scale coherent structures. Most active matter research deals with almost homogeneous in space systems and little is known about the dynamics of active matter under strong confinement. I will talk on experimental and theoretical studies on the expansion of highly concentrated bacterial droplets into an ambient bacteria-free fluid. The droplet is formed beneath a rapidly rotating solid macroscopic particle inserted in the suspension [1].   We observed vigorous inability of the droplet reminiscent of a supernova explosion [2]. The phenomenon is explained in terms of continuum first-principle theory based on the swim pressure concept. Furthermore, we investigated self-organization of a concentrated suspension of motile bacteria Bacillus subtilis constrained by two-dimensional (2D) periodic arrays of microscopic vertical pillars [3]. We show that bacteria self-organize into a lattice of hydrodynamically bound vortices with a long-range antiferromagnetic order controlled by the pillars' spacing. Our findings provide insights into the dynamics of active matter under extreme conditions and significantly expand the scope of experimental and analytic tools for the control and manipulation of active systems.

[1] A Sokolov and I.S. Aranson, Rapid expulsion of microswimmers by a vortical flow. Nature Commun, 2016, 7, 11114
[2] A Sokolov, LD Rubio, JF Brady, IS Aranson, Instability of expanding bacterial droplets,
Nature Commun 2018 9 (1), 1322
[3] D Nishiguchi, IS Aranson, A Snezhko, A Sokolov, Engineering bacterial vortex lattice via direct laser lithography, Nature Commun 2018, 9 (1), 4486

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